REMARKS

Claims 1-3 and 5-15 are presented for examination. Claims 1, 5-7 and 10-13 have been amended. Claims 4 and 16-31 were cancelled in the Amendment After Final Action filed on January 9, 2002. Claims 1 and 6 are independent.

Claims 1-3, 6-9 and 15 stand rejected under 35 U.S.C. §102(b) as being anticipated by EP 0 309 146 (*EP '146*).

Claims 1-3, 5-11 and 15 stand rejected under 35 U.S.C. §103(a) as being unpatentable over *EP '146* in view of U.S. Patent No. 5,263,250 (*Nishiwaki et al.*).

Claims 12 and 13 stand rejected under 35 U.S.C. §103(a) as being unpatentable over *EP '146* in view of *Nishiwaki et al.* and further in view of JP 2-187346 (*JP '346).*

Claim 14 stands rejected under 35 U.S.C. §103(a) as being unpatentable over *EP '146* in view of *Nishiwaki et al.* and further in view of U.S. Patent No. 5,548,894 (*Muto*).

Claim 1 is directed to a method for processing an ink discharge port of an ink jet head provided with discharge ports for discharging ink, the discharge ports being provided on a discharge port plate. The method comprises the steps of closely contacting a mask plate having openings corresponding to the discharge ports with a face of the discharge port plate on an ink discharge side, and forming the discharge port on the discharge port plate by irradiating plural high energy ultraviolet beams simultaneously through the mask plate so that the beams are inclined with respect to a vertical axis that is perpendicular to the mask plate. According to the method, the plural beams simultaneously irradiated to form a single discharge port are incident from different

directions on a region of the discharge port plate at which the single discharge port is to be formed, and the formed discharge port has a shape that widens in a direction away from a source of the beams.

By virtue of the method recited in Claim 1, a plurality of discharge ports each having a tapered shape (narrowing toward the ink discharge side) for enhancing discharge efficiency can be simultaneously processed from the ink discharge side of the discharge ports.

According to Applicants' understanding, *EP '146* relates to a method of manufacturing nozzles for ink jet printers. According to the method, laser radiation is applied to a mask in contact with a nozzle plate to ablate material of the plate so as to form the nozzles. During the ablation, the entire assembly, comprising the printhead, the nozzle plate and the mask, is rocked about the X and/or Y axes, which are disposed in or substantially in a plane of the nozzle plate facing the laser beam. The rocking permits the nozzles to be formed so as to have enlarged ink inlets without enlarging the nozzle exits. See *EP '146*, Abstract and col. 5, lines 16ff.

Thus, in *EP '146* a single discharge port is formed by applying a single laser beam to the nozzle plate at the location of the discharge port, and rocking the assembly (printhead, nozzle plate and mask) relative to the laser beam or, in other words, revolving the laser beam about the axis of the discharge port. In contrast, according to the arrangement recited in Claim 1, a single discharge port is formed at a given region on a discharge port plate by simultaneously irradiating plural beams in such a manner that the plural beams are simultaneously incident on the region from different directions.

Applicants submit that nothing in *EP '146* would teach or suggest that plural beams simultaneously irradiated to form a single discharge port are incident from different directions on a region of the discharge port plate at which the single discharge port is to be formed.

Further, according to Claim 1, the plural beams are inclined with respect to a vertical axis that is perpendicular to the mask plate. However, according to *EP '146*, the assembly is rocked relative to the laser beam so as to be inclined relative to the longitudinal and/or latitudinal axes of the mask itself, as shown in Fig. 2. Nothing in *EP '146* teaches or suggests inclination relative to an axis perpendicular to a mask plate. Applicants submit that nothing in *EP '146* would teach or suggest forming a discharge port on a discharge port plate by irradiating plural high energy ultraviolet beams simultaneously through a mask plate so that the beams are inclined with respect to a vertical axis that is perpendicular to the mask plate.

The requirement of *EP '146*'s method that the laser beam be revolved about the axis of the discharge port renders that method unable to yield advantages provided by the arrangement of Claim 1. For example, this aspect of *EP '146*'s method makes it difficult to process a plurality of discharge ports simultaneously. However, according to the method of Claim 1, simultaneous processing of a plurality of discharge ports is facilitated. In addition, during the course of forming a single discharge port using *EP '146*'s ablation and rocking method, different portions of the discharge port are processed at different times, and the reflectivity of the processed surfaces of the different portions may be uneven, which could result in distortion of the resultant shape of the discharge port. In contrast,

according to the method of Claim 1, in which a plurality of beams are simultaneously irradiated to form a given discharge port, the resultant shape of the discharge port is symmetric.

According to Applicants' understanding, *Nishiwaki et al.* relates to a method of manufacturing a nozzle plate for an ink jet printer. According to the method, a plurality of elongated beams are generated by dividing a laser beam, and the beams are applied to a fly-eye lens array, which further divides the beams into a plurality of elongated secondary beams. The secondary beams are bundled on a diaphragm to form a beam pattern, which is irradiated onto a nozzle plate through a mask. The method also involves several other optical elements such as prisms 61a and 61b to constitute a beam splitter, a condenser lens 10, and a projecting lens 14. The fly-eye lens itself is composed of a number of optical or lens elements. Nothing in *Nishiwaki et al.* teaches or suggests that its method forms discharge ports having a shape that widens in a direction away from a source of the laser beams.

Further, Applicants submit that *Nishiwaki et al.* cannot properly be combined with *EP '146*. Combining *Nishiwaki et al.* with *EP '146* would yield a method in which a plurality of beams are irradiated onto a nozzle plate via a mask, and the assembly (printhead, nozzle plate and mask) is rocked during the laser irradiation. In *Nishiwaki et al.*, however, a complex arrangement of multiple optical or lens elements is provided in order to generate the proper laser beams which will be incident on the mask at the proper positions. If *Nishiwaki et al.* were combined with *EP '146*, the rocking employed by *EP '146* would upset the balance *Nishiwaki et al.* achieves between the optical/lens

arrangement and the mask/nozzle plate, and would cause *Nishiwaki et al.*'s laser beams to be incident on the mask and nozzle plate at improper locations and/or with improper angles of incidence. As a result, the laser beams would not form discharge ports having the correct shape with precision. Accordingly, *Nishiwaki et al.* and *EP '146* implicitly teach away from each other, because combining these two references with each other would render both of them unsatisfactory for their intended purposes (e.g., of forming precisely shaped discharge ports).

According to Applicants' understanding, *JP '346* relates to an ink jet recording head and its manufacture. According to *JP '346*, laser beams are projected onto orifice plate 10 via mask 4 from an ink channel side, and the laser beams are converged by tilting with respect to optical axis 13. The formed orifices are tapered in shape so as to narrow in the direction of ink discharge. Applicants note that optical axis 13 is not perpendicular to mask 4 (see Figs. 4 and 6), and that the formed orifices do not widen in a direction away from the source of the laser beams (see Figs. 4 and 6).

JP '346 is cited in the Office Action (pages 4-5) as teaching "an ink jet head in which corresponding ink flow paths 14 (in Fig. 9) are rectangular in shape and are connected to a discharge port plate 10," and "the discharge port plate is made of a resin material, which is ablated by laser beams to form the discharge ports 11, and . . . the rectangular ink flow paths 14 are formed by the laser beams after the discharge ports are formed."

According to Applicants' understanding, *Muto* relates to an ink jet head having ink-jet holes partially formed by laser-cutting and a method of manufacturing the same.

According to *Muto*, a blank for a nozzle plate is formed by injection molding, and blind holes are formed in one of two opposite surfaces of the blank. The cross-sectional area of the blind holes decreases in a direction from the one opposite surface to the other. The blank is subjected to laser-cutting to prepare the nozzle plate having orifice holes which cooperate with the blind holes to form ink-jet holes.

Muto is cited in the Office Action (page 5) as teaching that "forming discharge port plates (nozzle plate 61) can be accomplished by conventional, art recognized equivalent materials of either resin or silicon nitride."

Applicants submit that neither *JP '346* nor *Muto*, whether taken singly or in combination (even assuming, for the sake of argument, that such combination were permissible), cures the deficiencies of *EP '146* and *Nishiwaki et al.* discussed above.

In conclusion, none of the cited references contains all of the elements of Claim 1. Even if a combination of *EP '146* and *Nishiwaki et al.* be deemed to teach all of these elements, these references cannot be properly combined. Accordingly, Claim 1 is believed patentable over the cited art. Since Claim 6 recites features similar to those of Claim 1, Claim 6 is believed patentable over the cited art for at least the same reasons.

A review of the other art of record has failed to reveal anything which, in Applicants' opinion, would remedy the deficiencies of the art discussed above, as references against the independent claims herein. Those claims are therefore believed patentable over the art of record.

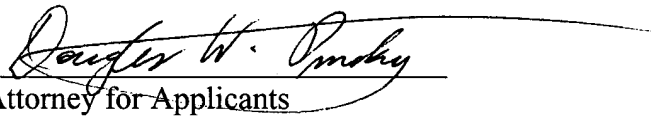
The other claims in this application are each dependent from one or another of the independent claims discussed above and are therefore believed patentable for at least

the same reasons. Since each dependent claim is also deemed to define an additional aspect of the invention, however, the individual reconsideration of the patentability of each on its own merits is respectfully requested.

In view of the foregoing amendments and remarks, Applicants respectfully request favorable reconsideration and early passage to issue of the present application.

Applicants' undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should continue to be directed to our below listed address.

Respectfully submitted,



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